Schedule 3

Framework Specification

Specification

T0445 A1 Ultrasonics written practice - Track

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1 Purpose

The purpose of this specification is to define London Underground's (LU) requirements for the control and administration systems for the training, examination and certification programmes for personnel who perform ultrasonic and Non-destructive Testing (NDT) on LU infrastructure.

2 Scope

This specification covers proficiency in Ultrasonic Testing of rail and associated components. It shall apply to the certification of all LU NDT ultrasonic operators, testers and third party suppliers completing ultrasonic and NDT testing on LU Track. It meets the requirements of BS EN ISO 9712 (ex. BS EN 473) and follows the guidelines set out in the American Society for Non-destructive Testing (ASNT) document SNT-TC-1A.

3 Qualifications

3.1 Level 1 Qualification

An individual certificated to Level 1 has demonstrated competence to carry out NDT according to LU procedure and under the control of Level 2 personnel. Within the scope of the competence defined on the specification, Level 1 personnel shall be qualified and authorised to:

a) Set up A-scan and B-scan NDT equipment (Lite Rail Tester and Single Rail Tester)

b) Perform the defined ultrasonic and non-destructive procedures (outlined in this document) including B-scan

c) Record and classify the results of the tests as required by LU

d) Interpret and report the inspection results

e) Take action as required by the relevant LU category 1 standard(s) and procedure(s).

f) Carry out necessary equipment checks

g) Mentor trainees as and when requested by the Level 2 supervisor.

Level 1 certificated personnel shall not deviate from the test method or technique being used. The syllabus for level 1 is set out in appendix 13.1

3.2 Level 1a Qualification

An individual certificated to Level 1a has demonstrated competence as per the Level 1 requirements, and is qualified, deemed competent, and trained and certified by the appropriate training body to complete the following:

a) Offline analysis of B-scan data, using the relevant software.

b) Interpret data and action identified rail flaws as required by LU standard(s) and procedure(s).

Note:	There may be instances where staff will only be undertaking the duties of a Level 1a qualification without being certificated to the Level 1 qualification (usually when only undertaking analysis duties). In this scenario the person shall receive an appreciation of Level 1 locally by the Ultrasonics Delivery Manager, who shall assess and deem the person competent in this appreciation before proceeding to certification in the Level 1a qualification. The Ultrasonics Delivery Manager shall restrict all such persons following this scenario to Level 1a qualification activities.

3.3 Level 2 Qualification

An individual certificated to Level 2 has demonstrated competence to perform non-destructive testing according to established and recognised procedures. Level 2 qualified personnel must already be qualified to Level 1a. Within the scope of the competence defined, Level 2 personnel may be authorised to:

a) Select the NDT technique(s) for the test method to be used

b) Define the scope and limitations of the application of the testing method

c) Be conversant with NDT standards and specifications

d) Set up and verify equipment settings

e) Perform and supervise inspections

f) Interpret and evaluate results according to applicable standards

g) Carry out and supervise all Level 1 duties

h) Provide guidance for personnel at or below Level 2

i) Carry out Level 1 renewal examinations at 24 monthly intervals.

To be eligible for certification, the candidate shall successfully complete the relevant qualification examination detailed in clause 8 and shall fulfil the requirements of training, industrial NDT experience and satisfactory vision defined in this clause. The syllabus for level 2 is set out in appendix 13.2.

3.4 Level 3 Qualification

An individual can qualify as a level 3 certified individual by satisfying one of the following criteria.

a) Have obtained a degree in engineering or science from a college or university (four year curriculum minimum), plus a minimum of one year experience comparable to Level II in the method or methods being certified,
or

b) Have satisfactorily completed two years of technical training (engineering or science at university, college, or technical school), plus two years of experience comparable to Level II in the method or methods for which being certified, or

c) Have four years of rail flaw detection experience in an assignment comparable to that of a Level 2 in the method(s) in which certification is sought.

d) If any of the above and nominated and deemed competent by LU.

In addition to one of the above, individuals must pass a basic, method and Level III examination to be administered by ASNT.

The Level 3 qualification examination structure and process relies partly on examination. The questions shall be similar to those found in the ASNT published Level 3 questions for each method. The syllabus for level 3 is set out in appendix 13.3.

4 Training and Examination Requirements

4.1 General requirements

4.1.1 NDT operators employed by LU or an approved contractor acting on behalf of LU shall, as a minimum, hold Level 1 certification in the relevant ultrasonic technique(s).

4.1.2 All operators that are initially trained and awaiting examination shall be considered a Trainee. A Trainee shall work only with a certified operator. The Trainee shall not independently conduct, interpret, evaluate or report the results of any NDT examination.

4.1.3 To achieve Level 1a certification, trainees must attend an analysis specific training course, delivered by a LU approved body. All analysis certified trainees must be issued with an authorising certificate.

4.1.4 In addition to the certification, operators shall also meet the following experience and surveillance requirements:

a) Following a minimum of 4 weeks after initial training and a minimum of 140 hrs practical experience, operators shall be assessed on site, by a member of the examination body to ensure they are conducting inspections competently and using the appropriate documentation. All other techniques shall be assessed at the examination centre on completion of training & relevant experience.

b) To maintain certification, operators shall undergo a renewal examination at 12 monthly intervals carried out by a Level 2 in the ultrasonic inspection of rail for each technique held, along with verification of visual acuity.

c) The examination shall be carried out within 1 month (before or after) the due date without affecting the due date for the 2 yearly re-certification examinations.

4.1.5 Any individual who directly supervises Level 1 NDT operators shall be required to be certified to Level 2 in the same methods and technique(s).

4.1.6 Candidates whose renewal examinations are not carried out within the timescales defined in this document shall have their certificates withdrawn and shall be required to pass a re-certification examination for each technique previously held, before undertaking further ultrasonic inspection.

4.1.7 Staff shall calibrate for all techniques held on a bi-monthly frequency as outlined in appendix 13.5.

4.1.8 Operators taking holidays or sickness leave for periods up to three months shall be deemed capable to resume inspection provided they have met the requirements up to the beginning of the period of absence.

4.1.9 Operators on holiday, sickness or leave for periods longer than three months shall not be allowed to resume testing until they have undergone a renewal examination (on all techniques previously held) carried out by a Level 2 or approved certification body.

4.1.10 Assessments shall be completed on track during the initial examination. Subsequent and all other techniques shall be assessed off-track on samples for initial and subsequent examinations.

4.1.11 The expiry date of the initial technique(s) certified shall be used for all renewal and re-certification examinations.

4.1.12 A candidate who fails any part of the renewal examination shall undergo a re-certification examination for each technique failed and shall not conduct the failed technique until he/she has passed the re-certification examination.

4.1.13 A candidate who fails to obtain the pass grade required for certification may retake any of the examination parts (general, specific or practical) once, provided that the re-examination takes place not sooner than one month, unless further training acceptable to the certification body is satisfactorily completed, nor later than twelve months after the original examination. A candidate failing re-examination shall apply for and take the examination in accordance with the procedure established for a new candidate.

4.1.14 Any candidate who, during the course of the examination, does not abide by the examination rules in place at the examination centre or who perpetrates, or is an accessory to, fraudulent conduct shall be excluded from further participation. A candidate failing for reasons of unethical behaviour shall wait at least 5 years before re-applying.

4.2 Training requirements

4.2.1 The minimum duration of training undertaken by the candidate for certification shall be 70 hours for both level 1 and 70 hours for level 2 training. Training hours include both practical and theory course.

4.2.2 A candidate moving from Level 1 to Level 2 requires further 70 hours training.

4.2.3 A candidate entering direct into Level 2 requires a minimum 140 hours training.

4.2.4 The minimum requirements for the duration of practical experience to be gained prior to assessment shall be four weeks (140 hours) for level 1 training and 70 hours for level 2 training.

4.2.5 Documentary evidence of mentored hours and practical experience shall be supplied and confirmed by the employer. Industrial NDT experience shall be demonstrated via attendance at an approved training course. Candidates shall provide proof that they have satisfactorily completed each course of training, in the method and level for which certification is sought, in accordance with the requirements of the certification body.

Note:	Hours are based on a 35 hour working week and shall be achieved within a timescale of 8 weeks for level 1 and 72 weeks for level 2, and shall be recorded for verification purposes at the examination.

4.3 Examination requirements

4.3.1 All re-certification examinations shall be conducted at LU approved examination centres.

4.3.2 At the examination the candidate shall have in their possession valid proof of identification.

4.3.3 An examiner shall not examine any candidate they have personally trained for that particular examination.

4.3.4 The general examination shall include only questions selected in an unpredictable way from the examination body's collection of basic knowledge questions valid at the date of the examination. The candidate shall be required, as a minimum, to give answers to the number of multiple-choice questions shown in the table below. Examinations shall only include questions selected from the examination body's current collection of specific questions related to ultrasonic and non-destructive testing of rail.

4.3.5 The candidate shall be required, as a minimum, to give answers to the number of multiple-choice questions shown in the table below for general examinations:

NDT Method	Number of Questions		Time Allowed
	Level 1	Level 2	
Ultrasonic testing	40	40	60 minutes
Magnetic particle testing (MPT)	30	30	60 minutes
Liquid penetrant testing (DPT)	30	30	60 minutes

Table 1: general examinations

4.3.6 The candidate shall be required, as a minimum, to give answers to the number of multiple-choice questions shown in the table below for specific examinations. During the specific examination, the candidate shall be required to give answers to at least the number of questions defined in the table below, including questions involving calculations, written procedures and questions on codes, standards and specifications.

NDT Method	Number of Questions		Time Allowed
	Level 1	Level 2	
Ultrasonic testing	20	20	30 minutes
Magnetic particle testing (MPT)	20	20	30 minutes
Liquid penetrant testing (DPT)	20	15	30 minutes
B-scan inspection	20	-	-
B-scan analysis	40	-	-

Table 2: specific examinations

4.3.7 For analysis inspection and training, the candidate shall be required to pass the specific examinations.

4.3.8 The candidate shall be required to achieve a pass mark of 70% in each sector with a composite grade of 80% (Appendix 13.4).

4.4 Practical examination requirements

4.4.1 The practical examination shall involve applying the test to prescribed test specimens, recording and interpreting the resulting information to the degree required and reporting the results in the required format.

4.4.2 Each test specimen (both ultrasonic and MPT/DPT) shall be uniquely identified and have a master report. The master sheet shall be completed based upon at least two independent tests and shall be validated by an authorised Level 3 certificate holder for use in grading examinations.

4.4.3 The average allowed time for each inspection shall be defined by the examination body. The time allowed for the examination depends upon the number of test specimens and their complexity, although guidance is given in the table below.

Test procedure	Number of samples/runs	Time allowed per test
U1	3	10
U5	3	20
U6	3	60
U7	3	15
U8	3	15
U10	3	35
U15	3	15
U16	3	15
U17	3	15
U18	3	45
U19	3	30
B-scan inspection	3	20
B-scan analysis	3	60

Table 3: examination times

4.4.4 The candidate shall be required to achieve a pass mark of 70% in each sector with a composite grade of 80% (Appendix 13.4).

4.4.5 The examination shall be invigilated and evaluated by an examiner, or by one or more trained and authorised invigilators placed under the examiner's responsibility.

4.4.6 A candidate for a practical examination may use his own apparatus. All data stored in memory would require to be erased before and after examination, to the satisfaction of the examiner.

4.4.7 For B-scan inspection, candidates shall undertake dummy inspection, which shall be invigilated by the LU approved certified training body.

4.4.8 For analysis training, candidates shall undertake dummy run analysis, which shall be invigilated by the LU approved certified training body.

4.5 Vision requirements

4.5.1 Candidates shall provide evidence that vision requirements are satisfactory as determined by an oculist, optometrist, or other medically recognised person or a Company Level 2 (or designated person trained in carrying out vision tests) in accordance with the following requirements:

a) Near vision acuity shall permit reading a minimum of Jaeger number 1 or Times Roman N 4.5 or equivalent letters at not less than 30cm with one or both eyes, either corrected or uncorrected.

b) Colour perception tested by the Ishihara method carried out at not less than 70cm. The candidate shall be tested on 24 plated and be successful in at least 20 plates during the re-certification examination and be tested on 6 plates and be correct on all 6 at the renewal examination.

4.5.2 The documented tests of visual acuity according to the above shall be carried out annually and shall form part of the assessment records.

5 Certification

5.1 A candidate fulfilling all conditions for certification shall be issued with a certificate. Certificates shall include:

a) The name of the certificate holder

b) The date of issue of the certification

c) The date that the certification expires

d) The level of certification

e) The NDT method and technique certified

f) A unique personal identification number

g) The examination boards authorisation & signature

h) Renewal assessment due date

5.2 The maximum period of validity of the certificate will be three years. The initial period of validity shall commence when all the requirements for certification (training, experience, success in examination and satisfactory vision test) are fulfilled. Certification shall be renewed by the certification body for a period of three years.

5.3 Level 1 re-certification shall include a three yearly renewal examination, undertaken by the company Level 2 or Level 3 NDT supervisor on the basis of the following requirements:

a) The individual shall successfully complete a practical examination for all NDT techniques being re-certificated (two sample per procedure)

b) Verification of visual acuity as described in this specification

5.4 Level 2 certification shall be renewed by the certification body for a period of three years on the basis of the following requirements:

a) The individual shall successfully complete a practical examination for all NDT techniques being re-certificated

b) Verification of visual acuity as described in this document

c) Verification of Level 1 renewal examinations

d) The individual shall demonstrate knowledge and understanding of new standards, regulations, codes and specifications

e) The individual shall demonstrate knowledge and understanding of new techniques, equipment and processes

f) The individual shall demonstrate the ability to interpret, and evaluate results according to applicable standards.

5.5 An NDT operator passing the re-certification examination shall be issued with a copy of their new certificate before leaving the examination centre and the original shall be posted to the relevant supervisor within 14 calendar days.

5.6 An NDT operator failing the re-certification examination shall not be issued with a certificate and their supervisor shall be informed that day by phone call or text message and in writing via email or post. The NDT operator shall not carry out inspection until a further re-examination takes place and the relevant pass marks are obtained.

5.7 Candidates shall be recertified in B-scan analysis every two years by the relevant LU approved certified training body. The recertification may be completed via an approved training e-learning method supplied by the training body, under the supervision of the company Level 2 or Level 3 NDT supervisor.

5.8 Certification shall be withdrawn and become invalid if any of the following occur:

a) After reviewing unethical behaviour (against which is detailed in appendix 13.4)

b) If the individual becomes physically incapable of performing his or her duties based upon failure of the visual acuity examination taken every 12 months under the responsibility of his employer

c) If a significant interruption of greater than 3 months takes place in the method(s) for which the individual is certificated

d) If the individual fails the 12 monthly renewal or re-certification examinations, only the failed technique shall be withdrawn.

5.9 An operator transferring between employers shall undergo a re-certification examination before being issued with an operating authorisation by his new employer, unless specifically agreed by the nominated Level 3 manager for LU.

5.10 NDT certification obtained through this specification is not transferable between employers. When an operator's employment is terminated, their operating authorisation and certification shall be withdrawn.

6 Responsibilities

6.1 Training body

The training body shall:

a) Initiate, promote, maintain and administer training in accordance with this specification

b) Have an adequately staffed and equipped training centre

c) Prepare and supervise training courses under the responsibility of a Level 3

d) Apply a documented quality management system

e) Ensure that training specimens are not used for examination purposes

f) Deliver training appropriate to the following syllabus: Level 1 - as per clause 13.1, Level 2 as per clause 13.2, Level 3 as per clause 13.3.

g) Establish an appropriate system for the maintenance of records, which shall be retained for a period of 5 years.

h) Be responsible for the issue of all training certificates

i) Monitor, in accordance with a documented procedure, all delegated functions.

6.2 Examination body

The examination body shall:

a) Work under the control of the Level 3

b) Apply an approved documented quality procedure

c) Have the resources needed to administer examinations

d) Prepare and conduct examinations under the responsibility of a Level 3

e) Ensure that renewal examination test specimens are not in use for training purposes

f) Have adequate qualified staff, premises and equipment to ensure satisfactory qualifications for the level, methods and sectors concerned

g) Use only those documents and examination questions established and approved by a Level 3

h) Use only test specimens prepared or approved by a Level 3 for the practical examinations

i) Maintain appropriate qualification and examination records

j) Shall be responsible for the issue of all examination certificates within 14 days of examination date.

k) Shall retain and make available test specimens of comparable difficulty containing similar discontinuities to that found in LU infrastructure.

6.3 Employer (LU)

The employer (LU, or an approved agent acting on behalf of LU), with regards to the certificated persons, be responsible for:

a) The verification of the visual acuity in accordance with this document

b) Generating and retaining auditable records as a means of demonstrating operators have maintained their work experience and competence examinations in accordance with this Standard

c) Verification of continuity in the application of the NDT method without significant interruption of periods greater than 3 months

d) 12 monthly renewal examinations of Level 1 operators

Note:	For company level 1 operators, the company level 2 supervisor shall carry out the above process. The nominated company level 3 operator shall issue the companies level 2 authorisation.

7 Records

7.1 The examination body shall maintain, either in hard copy or read-only digitised form:

a) A database of all certificated individuals classified according to level, method and techniques

b) Individual file(s) for each certificated individual and for each individual whose certification has lapsed containing – examination documents, such a questionnaires, answers, description of specimens, test reports and examination results. This applies to all Level 1 Level 2 operators.

c) Re-certification documents, including evidence of visual acuity

d) Evidence of renewal examinations for Level 1's.

e) Records shall be available for audit within 48 hours of notification from LU

7.2 Individual files shall be kept under suitable conditions of safety and confidentiality for as long as the certification remains valid and for at least 5 years after the certification has expired.

8 References

British and European Standards

Document no.	Title or URL
BS 11	Specification for railway rails (Note: this is withdrawn but remains available as a reference for the profile of 95RBH bullhead rail)
EN 13674-1	Railway applications – Track – Rail – Part 1: Vignole railway rails 46 kg/m and above
EN 14730-1	Railway applications – Track – Aluminothermic Welding of rails – Part 1: Approval of welding processes
EN ISO 3834	Quality requirements for fusion welding of metallic materials - Part 2: comprehensive quality requirements

LU company documentation

Document no.	Title or URL
S1178	Rail Defect Management
S1171	All Plant - Acceptance, Use and Maintenance
S1173	Non-Railborne Plant - Design and Acceptance
T0450	Performance Specification for Ultrasonic Rail Flaw Detection Equipment
PR0113	Management of ultrasonic testing and management of rail defects
W1346	Testing (non-destructively) by magnetic particle testing
W1347	Testing of rails (non-destructively) by liquid penetrant testing
G3223	Track Handbook 23 – Managing Rail Defects
TBC	U6 ultrasonic procedure

Network Rail & NDT documentation

Document no.	Title or URL
BS EN ISO 9712	Non-destructive testing. Qualifications and certification of NDT personnel
SNT-TC-1A	Recommended practice for personnel qualification and certification of NDT personnel
NR/SP/TRK/055	Network Rail standard - Rail Testing – Ultrasonic Procedure and Techniques
NR/SP/TRK /057	Network Rail standard – Rail Failure Handbook
NR/SP/TRK/001	Network Rail standard – Track Inspection Requirements

9 Definitions

Term	Definition	Source
Qualification	Evidence of training, professional knowledge, skill and experience as well as physical fitness to enable NDT personnel to properly perform NDT tasks	Glossary
Certification	Document issued under the rules of the certification system defined in the standard indicating that adequate confidence is provided that the named person is competent to perform the NDT tasks defined on the certificate.	
Certification body	Body acting on behalf of LU that administers procedures for certification of NDT personnel according to the requirements of this Written Instruction.	
Examination centre	Centre approved by LU where qualification examinations will be carried out.	
Examiner	A person certified to Level 3 in the method he/she is to examine and authorised by the certification body to conduct, supervise and grade NDT qualification examinations.	

Trainee	A Trainee is a Candidate who has been trained in U1, U2 and is awaiting the assessment following a minimum 4-week period. A Trainee shall be mentored by a certificated Ultrasonic Operator, who shall be responsible for overseeing and signing for the inspections carried out by the Trainee.	
Certification	Document issued under the rules of the certification system defined in the standard indicating that adequate confidence is provided that the named person is competent to perform the NDT tasks defined on the certificate.	
NDT Candidate	Individual seeking qualification and certification;	
Employer	Organisation for which the candidate works on a regular basis.	
Operating Authorisation	Written statement issued by the employer, based on the individual's competence as specified within the certificate.	
NDT Method	Discipline adding a physical principle in non-destructive testing (for example: ultrasonic testing).	
NDT Technique	Specific way of utilising an NDT method	
NDT Procedure	Written description of all essential parameters and precautions to be observed when applying an NDT technique to a specific test; an NDT procedure can involve the application of more than one NDT Method or techniques.	
Multiple choice examination question	Wording of a question giving rise to four potential replies, only one of which is correct, the remaining three being incorrect or incomplete;	
Qualification examination	Examination administered by the certification body, which assesses the general, specific and practical knowledge and the skill of the candidate.	
General examination	Examination that is concerned with the principles of a NDT method.	
Specific examination	Examination that is concerned with the testing techniques applied in the railway sector, knowledge of the product being tested, and of standards, codes, specifications and acceptance criteria.	
Re-certification examination	An examination carried out by the Certification body at 24-month intervals.	
Renewal examination	An examination carried out by a Level 2 at the interim 12 months, carried out every 24 months thereafter.	
Practical examinations (Level 1 & 2)	Examination of practical skills, in which the candidate demonstrates familiarity with, and the ability to operate the test equipment and the ability to detect record & classify rail flaws.	
Industrial NDT experience	Experience in the applicable NDT method and field application concerned, which leads to the required	

	skill and knowledge,	
Significant interruption	Absence of greater than 3 months, or change of activity for a duration greater than 3 months, which prevents the certified individual from practising the duties corresponding to his level in the method and sector(s) for which he is certified.	
Samples used in practical examinations	Samples should during testing and training; shall be representative of products typically tested in the applicable sector.	
Level of certification	NDT Operators employed by LU or an approved Agent acting on behalf of LU shall, as a minimum, hold Level 1 certification in the relevant ultrasonic technique. NDT Supervisors employed by LU shall hold Level 2 certification in the relevant ultrasonic techniques held by the level 1's under his supervision.	

10 Abbreviations

Abbreviation	Meaning
NDT	Non-Destructive Testing
MPT	Magnetic Particle Testing
DPT	Dye Penetrant Testing
LU	London Underground
RCF	Rolling Contact Fatigue
LRT	Lite Rail Tester (Sperry RS125 and LRT B-scan equipment)
SRT	Single Rail Tester (CATER equipment)

11 Person accountable for this document

Name	Job title
Andrew Brice	Professional Head of Permanent Way

12 Document history

Issue no.	Date	Changes	Author
A1	July 2019	New specification produced as per change request No. CR-11650.	Daniel Harrison

13 Appendix

13.1 Training and examination syllabus (level 1)

1 Introduction

- Definition of ultrasonics
- History of ultrasonic testing
- Applications of ultrasonic testing
- Basic mathematics review
- Responsibilities of levels of certification

2 General Theory

2.1 Essential features of ultrasonic testing:

- Wave properties – types of wave, vibration, pulse, frequency, velocity, wavelength, units, relationship between frequency, velocity and wavelength
- Principles of reflection and transmission of sound waves at perpendicular incidence. Effect of coupling media and transmission of sound waves at perpendicular incidence.
- Principles of reflection and refraction of sound waves at incidental incidence. Factors affecting angles of reflection, refraction and mode conversion.
- Mode conversion echoes due to geometry.
- Effect of reflector on echo response.
- Sound field – influence of frequency, sound velocity and size of transducer. Estimate of near field, far field and beam divergence.
- Influence of properties of test object on sound propagation, sound velocity, attenuation, geometry and surface condition.

2.2 Equipment:

- Construction and mode of operation
- Block diagram of an ultrasonic instrument with single and double transducer, controls and functions of ultrasonic instrument.
- Types of probe – normal beam, single and twin crystal, angle beam. Construction and mode of operation.
- Signal presentation – A, B and C scans.
- Definition and use of decibel.
- Test methods – manual, semi-automatic and automatic.

2.3 Equipment checks, testing and techniques

- Pulse-echo technique – basic principle, measured values (transmit time, echo amplitude), advantages and limitations
- Through transmission technique – basic principle
- Application of compression and shear waves
- Coupling – contact technique, gap scanning and immersion technique.

3 Sector Specific Theory

3.1 Sector specific theory calibration of testing systems

- Timebase calibration – normal, single, twin crystal and angle beam probes.
- Calibration blocks and sensitivity checks. Effect of different sound velocities in calibration block and test piece.
- Sensitivity and signal to noise ratio.
- Effect of finish, geometry, attenuation in specimen
- Probe index, beam angle, squint and pulse duration

3.2 Detectability of defects:

- Advantages and limitations of the test method with regard to defect detection

3.3 Factors affecting the performance of the ultrasonic test:

- Mechanical properties of the material, attenuation
- Sound behaviour in rail
- Surface condition

3.4 Codes of Practice and Standards:

- S1178 – Rail Defect Management (LUL)
- T0445 – LU Ultrasonics Written Practice
- Network Rail Standard RT/CE/S/055 – Rail Testing – Ultrasonic Procedures
- Network Rail Standard RT/CE/S/057 – Rail Failure Handbook
- Network Rail Standard RT/CE/S/103 – Track Inspection Requirements
- PWSI 4 – Instruction on Management of Rails to Control RCF

3.5 Conducting and recording the tests

- Scanning techniques for rail defects
- Minimum actions and reporting requirements

4 Practical Techniques

- U1 - Ultrasonic inspection of fishplated joints and holes in plain line using hand held transducers.
- U5 - Ultrasonic assessment of rail head defects to determine horizontal length and vertical depth of reported discontinuity.
- U8 - Conformation and Examination of Vertical Longitudinal Split Defects
- U15 - Ultrasonic testing of rail using the Sperry roller search unit rail testing system including identification & sizing
- U16 - Ultrasonic testing of fishplated rail joints and bolt holes using the Sperry roller search unit rail testing system
- U17 - Ultrasonic testing of rail foot for transverse cracks under the web using the Sperry roller search unit rail testing system
- CATER SRT – Manual handling, Setup, calibration (U15/16/17) and use as defined in the manufactures approved and current training manual
- Sperry LRT – Manual handling, Setup, calibration (U15/16/17) and use as defined in the manufactures approved and current training manual

4 Analysis (Level 1a Analysis training only)

- Review of how B-scans are generated
- Data download and output
- B-scan signal interpretation and software navigation training
- Examples of defect types in B-scan form
- Analysis criteria
- Completion of analysis reporting spreadsheets
- Exporting and saving data correctly
- Applying action codes from the analysis criteria and line categories
- Creation of analysis reports
- Practical review and interpretation of collected data
- Hand testing and recording in A-scan (LRT (B-scan) only)
- Questions/Answers
- Examination

Marking Schedule

The following criteria apply to level 1 certification.

- 80% - 100% - Pass
- 50% - 79% - Reassessment
- Less than 50% - Retraining

13.2 Training and examination syllabus (level 2)

All of the syllabus for Level 1 and, in addition:

1 Principles of ultrasonic testing:

- Physical properties
- Behaviour of sound wave for perpendicular incidence. Acoustic impedance. Reflection and transmission factors. Calculations of reflected and transmitted energy.
- Behaviour of sound wave for inclined incidence. Snell's Law concerning reflection, refraction and mode conversion. Critical angles. Calculations
- Interpretation and prediction of boundary echoes.
- Time base position of mode converted echoes under known conditions
- Influence on sound waves of reflector size (reflection, scatter, refraction interference)
- Echoes from defined reflectors. Laws concerning distance and size of back-wall echo, side drilled holes and disc reflectors. Comparison with real flaws.
- Generation of ultrasonic waves. Electromechanical transducer (piezo-electric). Properties of the transducer (nominal and working frequency, band width). Effect of different transducer materials.
- Sound field. Calculation and estimation of near field, far field and beam spread.
- Influence on specimen material properties on sound propagation, attenuation, cause, effect and measurement.

2 Equipment

- Probe construction and mode of operation. Special probes, double crystal angle probes, focused probes, probes with different damping.
- Measurement of resolving power of angle probes. Correlation between resolution, frequency, penetrating power and damping
- Amplifier characteristics, broad and narrow band, linearity, suppression and DAC correction
- Signal presentation. Deeper knowledge of automatic test systems (b-scans)
- Equipment checks

3 Sector Specific Theories

Calibration of test systems:

- Timebase calibration – projected distance. Effect of different materials.
- Calibration for sensitivity with reference to back-wall echo, flat bottomed holes and side drilled holes

Detectability of Defects:

- Advantages and limitations of the test method with regard to defect detection

Factors affecting the performance of the ultrasonic test:

- Relationship of material properties and surface condition and attenuation and sound velocity
- Selection of probe type, frequency and angle
- Preparation of test surface
- Selection of couplant and testing technique
- Influence of defect type, position and orientation on detection

Codes of Practice and Standards:

- BS EN ISO 9712 – Non-destructive testing – Qualification and Certification of NDT Personnel
- Recommended Practice No. SNT-TC-1A - Personnel qualification and Certification of NDT Personnel
- S1178 – Rail Defect Management (LUL)
- T0445 - LU Ultrasonics Written Practice
- Network Rail Standard RT/CE/S/005 – Rail Testing – Portable Ultrasonic Equipment
- Network Rail Standard RT/CE/S/055 – Rail Testing – Ultrasonic Procedures
- Network Rail Standard RT/CE/S/014 – Rail Testing – Detection Criteria
- Network Rail Standard RT/CE/S/057 – Rail Failure Handbook
- Network Rail Standard NR/SP/TRK/001 – Track Inspection Requirements
- PWSI 4 – Instruction on Management of Rails to Control RCF
- Establishing of testing instructions considering application, equipment, technique, probes, calibration, operation of test, recording of results.

Conducting and recording the tests:

- Procedure to be adopted to carry out the test
- Information to be recorded on the report
- Flaw assessment and reporting Interpretation of test results to acceptance standards

4 Product Technology Theory

- Basic Production – crude and finished products:
- Grades of steel: steel making processes. Ingot types (narrow end up and wide end up), concast methods (continuous casting methods). Definition used in the production of ingots and casting.
- Difference between ingot and concast production processes. Ingot casting for further hot working, rolling, forging and extrusion.
- Forging processes and basic forging defects - the appearance of defects and how they are found; forging bursts, laps, seams and cracks
- Heat Treatment - What stress relieving is and why it is carried out Inspection:
- Brand marks, surface condition, dimensional checks and effect of grinding
- Defects arising in service - causes and rectification
- Rail joining processes - Thermit welding, Flash butt welding and fishplated joints

5 Renewal examinations

- How to verify vision requirements
- How to set up the renewal examination program
- How to carry out the renewal examinations
- What requires to be recorded and actions arising
- Storage of examination test pieces
- Issue of operating authorisation

Marking Schedule

The following criteria apply to level 2 certification.

- 80% - 100% - Pass
- 50% - 79% - Reassessment
- Less than 50% - Retraining

13.3 Training and examination syllabus (level 3)

Taking into account the scientific and technical potential of candidates for level 3 certification, it is considered that preparation for qualification can be achieved in various ways; by taking training courses, attending conferences or seminars and by studying books, periodicals or other specialised material.

However the level 3 candidate prepares for examination, he or she shall demonstrate to the satisfaction of the certification body than an acceptable degree of appropriate training of at least the duration required for level 2 candidates has been attained in the NDT method for which certification is sought.

Industrial Experience

Level 3 responsibilities require knowledge beyond the scope of any specific NDT method.

All candidates for level 3 certification in any NDT method shall have successfully completed (having achieved a mark of not less than 70% in any one examination module) the practical examination for level 2 in that method in one or more categories except the drafting of practical instructions for level 1.

Qualification Examination Content

The level 3 qualification examination is comprised of a basic examination and a main examination.

Basic Examination:

In the basic examination the candidate shall demonstrate the following:

- In a closed book examination, technical knowledge and understanding of materials science and technology, including production and in-service defects in a wide range of products, including castings, welds and wrought products.
- In an open book examination, knowledge and understanding of the qualification and certification system defined in this document.
- In a closed book examination, general knowledge and understanding of at least four methods at level 2 standard chosen by the candidate from the ET, PT, MT, RT, UT and VT methods. The four chosen methods shall comprise the principle method for which certification is sought and three others, which must include at least one volumetric method (UT or RT) unless UT or RT is the principle method.

Number of Basic Examination Questions:

- Materials technology and science, including typical defects in a wide range of products including castings, welds and wrought products.(30 Questions)
- Qualification and certification procedure in accordance with this document. 10 Questions.
- 15 general questions at level 2 standard for each of four NDT methods, including at least one volumetric NDT method (UT or RT). (60 Questions).

Main Method Examination

The main method shall consist of:

- A general examination covering the level 3 knowledge relating to the test method for which certification is sought.
- A specific examination relating to the application of the NDT method in the industrial sector concerned, including the applicable codes, standards, and specifications (the candidate will be provided with any relevant code, standard or specification).
- A main method examination question consisting of 30 general multiple choice questions, 20 specific multiple choice questions, and a practical exam to demonstrating the drafting of one or more NDT procedures specific to the rail sector.

The successful candidate for level 3 certification may be issued level 2 certification in the same NDT method and sector without further examination provided the relevant practical examination was passed in order to gain the level 3 certification concerned. The resultant level 2 certification will be valid for only those categories in which success in the practical examination was achieved and will expire on the same date as the related level 3 certification and the procedure for revalidation will be the same as for any level 2 certificate.

Marking Schedule

The following criteria apply to level 3 certification.

- 80% - 100% - Pass
- 50% - 79% - Reassessment
- Less than 50% - Retraining

13.4 Code of ethics for NDT Operators

Codes of ethics for NDT Operators – operators shall undertake to:

- Comply with this code of ethics.
- Only undertake testing which they are competent by virtue of their training, qualification and experience.
- Only sign documents for testing which they have personal professional and / or direct supervisory control.
- Conduct themselves in a responsible manner and utilize fair and equitable business practices in dealing with colleagues, clients and associates.
- At all times, be aware of and uphold the provisions / requirements of codes, regulations and standards under which they are working.
- Immediately report to their supervisor / manager any perceived violation(s) of codes, regulations or standards.
- Perform their professional duties with proper regard for physical environment and the safety, health and well-being of the public.
- Protect to the fullest extent possible, consistent with the well being of the public and the provisions of this code of ethics, any information given to them in confidence by an employer, colleague or member of the public.
- Strive to maintain their proficiency by updating their technical knowledge as required to properly practice NDT in the certified methods and levels.
- Indicate to the employer or client any adverse consequences which may result from an overruling of their technical judgement by a non-technical authority.
- Not falsify nor permit misinterpretation of their own or their associate's academic or professional qualifications, training, experience or work responsibilities.
- Refrain from making unjustified statements or from performing unethical acts which would discredit the competency scheme.
- Immediately report to their supervisor / manager, any attempt to pressure or force an individual to violate this code of ethics.
- Inform their supervisor / manager in the event that their NDE certification is suspended, cancelled or withdrawn.

13.5 Bi-monthly calibration process

This process to be carried out on a 2 monthly cycle by Technicians, Inspectors & Team Leaders:

- Operator to calibrate equipment against NR/SP/TRK/055 for all certified procedures.
- Operator to fill in F0124 - Ultrasonic operators journal (where relevant) for each calibration.

- Ultrasonics delivery manager or designated authority to countersign completed journals.
- Record sheet to be copied to Ultrasonics delivery manager.
- Ultrasonics Delivery Manager to retain records locally.

Schedule 4

Form of Order

To be supplied by individual Purchase Orders which will be linked back to this Outline Agreement and therefore subject to the Terms and Conditions of this Agreement.

Schedule 5

Contract Variation Procedure

1 The cost of any Variation Order shall be agreed between the parties taking account of the reasons why the Variation Order was required.

2 The Company may propose a variation by completing Part A of the Variation Proposal and supplying three (3) copies of it to the Supplier. Within five (5) Working Days of receipt, or such other time as may be agreed by the Company, the Supplier shall complete Part B of the Variation Proposal and shall supply two (2) copies of the Variation Proposal to the Company. The Company shall be entitled, at any time within thirty (30) days of receipt, to instruct and authorise the Supplier to proceed with the variation on the terms so set out by each party by completing and signing Part C of one copy of the Variation Proposal (which, following such signature, will be referred to as a "**Variation Order**") and supplying such Variation Order to the Supplier. The relevant part(s) of the Agreement and any Contract shall thereupon be varied accordingly.

3 The Supplier may propose a variation, after requesting the issue by the Company of a Variation Proposal variation number, by completing Parts A and B of a Variation Proposal and supplying two (2) copies of it to the Company. The Company shall be entitled, at any time within thirty (30) days of receipt, to instruct the Supplier to proceed with the variation on the terms so set out by the Supplier by completing and signing Part C of one copy of the Variation Proposal (which, following such signature, will be referred to as a "**Variation Order**") and supplying such Variation Order to the Supplier. The relevant part(s) of the Agreement and any Contract shall thereupon be varied accordingly.

4 The Supplier may indicate in a Variation Proposal that the price is an estimated price but, if it does so, it shall supply a firm price to the Company in writing at least seven (7) days before the expiry of the time within which the Company is entitled to instruct the Supplier to proceed with the variation.

5 The price indicated by the Supplier must be the full price and shall cover all costs associated with the variation. If appropriate a range of prices may be shown corresponding to the extent of the Services to be carried out.

6 In an emergency, both parties shall use their reasonable endeavours to expedite the actions permitted or required under the Contract Variation Procedure.

7 The Company will not accept any retrospective claims for additional work caused by a variation which has not been approved by the Company in accordance with the Contract Variation Procedure before the commencement of such additional work.

8.1 All authorised additional work resulting from any Variation Proposal shall be priced in accordance with any applicable rates set out in Schedule 2.

8.2 The Supplier shall at all times act reasonably and shall price each Variation Proposal at the least possible additional cost to the Company that it is reasonably and economically practicable for the Supplier to offer and which has the least possible impact on the terms of the Agreement and any Contract, including but not limited to, the Specification and the Order Programme.

9. Strict adherence to the procedure described in this Schedule 5 shall be a condition precedent to any addition to the price for the Services. If the Supplier does not adhere to each paragraph in this Schedule 5 then the Supplier shall not be entitled to any addition to the price for the Services notwithstanding that the Supplier may have supplied additional or varied Services.

Appendix 1

Form of Variation Proposal/Variation Order

To:	From:

Contract Reference:
Variation Number:
Variation Title:

PART A (TO BE COMPLETED BY THE ORIGINATOR OF THE VARIATION ORDER)	
Description of change:	
Reason for changes and impact (if any) on Agreement:	
Variation Proposal Authorised by:	**Proposal Date:**

PART B (TO BE COMPLETED BY THE SUPPLIER)	
Price Breakdown Note: If a further breakdown is needed please append details as a separate sheet.	
Expected Delivery Date:	
Supplier's Representative: **Print Name:** ..... **Signature:** ..... **Date:**	
Completed document to be returned to the Company's Representative	

PART C (TO BE COMPLETED BY THE COMPANY'S REPRESENTATIVE)
Comment on Parts A and B:
Variation Authorisation **Company's Representative:** **Print Name:** ..... **Signature:** ..... **Date:** .....

Schedule 6

QUENSH

F0780 A18 Contract Menu

This Contract Menu must be used in conjunction with Category 1 Standard S1552 "Contract QUENSH Conditions''

Contract Menu

Contract No:	TfL 01172
Contract Name	Supply of Non-Destructive Testing (NDT) Rail Inspection Training Services
Client:	London Underground Limited
Supplier:	Serco Limited

Principal Contractor: **Yes** ❑ **No** ✓

Guidance

The menu is a tool which is used by the Client to identify conditions that apply to specific contracts and communicate these conditions to the Supplier.

How to complete the menu

1) The Client evaluates the scope of work and enters 'Y' or 'N' in the 'Identified by the Client' column of the menu against each condition selected as applicable or not applicable to the Contract. In the 'Other documents / comments' column the Client can make references to other documents which are supplementary information which is available although not contained within the QUENSH manual but should be considered by the Supplier when they review the conditions. Copies of any additional documents identified in the menu shall be made available to the Supplier. All documents referenced in the Menu shall be current issue, unless otherwise advised. This column can also be used to communicate information (comments) to the Supplier which may be of use to the Supplier when reviewing the conditions.
2) The Client fills in 'Client menu (Invitation to Tender)' section on the last page of the menu and issues the menu as part of the ITT.
    a) The Supplier receives the ITT, evaluates the scope of work and, as a requirement of the tendering process, inserts 'Y' or 'N' in the 'Identified by the Supplier' column of the menu against each condition selected as being applicable. These selections may be different from those identified by the Client. Where the Supplier's selection differs from the Client's selection, a clear explanation of the reason for these differences shall be given by the Supplier. A reference to these explanations shall be put in the 'Reference to explanation' column on the menu.
    b) The Supplier representative signs and dates the 'Supplier menu (Tender)' on the last page of the menu and submits it with the tender, for consideration by the Client.
    c) Differences in the Client and Supplier menu selections will be discussed and resolved with the Client at subsequent tender review meetings. The agreed final version of the menu selections shall form a mandatory part of the Contract and shall be complied with by all Suppliers and their sub-contractors.
    d) The menu shall be subject to project version and document control.

Queries on the menu

Any queries in relation to the Contract QUENSH Conditions selected on the menu are to be referred to the Client representative, see contact details/address on last page of the menu.

Contract menu

Requirements in QUENSH

Applicable requirements identified by Client				Applicable requirements identified by Supplier	
Section	**Topic**	**Other documents / Comments**	**Y / N**	**Y / N**	**Reference to explanation - see Section 2a in attached Guidance Notes**
4	Agreement of the applicable QUENSH contract conditions				
5	Supplier's selection of sub-contractors		N	N	
6	Identification of Safety Critical Activities		N	N	
7	Works Environmental Management		N	N	
8	Emergency Plan		N	N	
9	Method Statements		N	N	
10	Health, Safety and Environment File		N	N	
11	Pre-start LU health, safety and environment meeting		N	N	
12	Supplier's site induction		N	N	
13	Site Person in Charge		N	N	
14	**Staff requirements**				
14.1	**Behaviours**				
14.1.1	Alcohol and drugs		Y	Y	
14.2	**Control of hours worked**				
14.2.1	Working Time Regulations		Y	Y	
14.2.2	Fatigue		Y	Y	
14.3	**Knowledge**				
14.3.1	English language		Y	Y	
14.3.2	Access Card and Worksite Briefing		Y	Y	
14.3.3	Visitors to sites		Y	Y	
14.4	**General competence**				
14.4.1	Evidencing competence of safety critical staff		N	N	
14.4.2	Identification of safety critical staff		N	N	
14.4.3	Competent external safety critical personnel		N	N	

Applicable requirements identified by Client				Applicable requirements identified by Supplier	
Section	**Topic**	**Other documents / Comments**	**Y / N**	**Y / N**	**Reference to explanation - see Section 2a in attached Guidance Notes**
14.4.4	Training		Y	y	
14.4.5	Asset specific competence		Y	Y	
14.5	**Medical requirements**		Y	Y	
14.6	**Identification of Suppliers staff**		Y	Y	
14.7	**Clothing**		Y	Y	
15	**Permits and licences**				
15.1	LU specific permits and licences		Y	Y	
15.2	Permits, licences and certificates for Supplier's staff		Y	Y	
16	**The Principles of Access**				
16.1	Introduction		N	N	
16.2	Access to Stations		Y	Y	
16.3	Access to Track		Y	Y	
16.4	Access to depots		Y	Y	
17	**Applying for Planned Access**				
17.1	Introduction		N	N	
18	Applying for General Access		N	N	
18.1	Constraints that apply to Generic Access		N	N	
19	Access for fault repair		N	N	
20	Operational Assurance		N	N	
21	**Closures and possessions**				
21.1	Requirements for closures		N	N	
21.2	Requirements for possessions		N	N	
22	**Controls at point of access**				
22.1	Publication of works		N	N	
22.2	Checks at point of access		N	N	
22.3	Signing-on with the Station Supervisor		Y	Y	
22.4	**Track specific requirements**				
22.4.1	Person providing protection		N	N	

Applicable requirements identified by Client				Applicable requirements identified by Supplier	
Section	**Topic**	**Other documents / Comments**	**Y / N**	**Y / N**	**Reference to explanation - see Section 2a in attached Guidance Notes**
22.4.2	Possessions		N	N	
23	Removal of supplier's personnel from LU Premises		N	N	
24	Incidents		Y	Y	
25	Notification of regulatory concern or action		Y	Y	
26	Confidential Incident Reporting and Analysis System (CIRAS)		Y	Y	
27	**Monitoring**				
27.1	LU inspections		Y	Y	
27.2	Monitoring the supply chain		Y	Y	
27.3	Health, safety and environmental surveillance by the supplier's personnel		Y	Y	
27.4	Work location inspection and audit		N	N	
27.5	Timescales for rectifying non-compliances		N	N	
28	Radio transmitters and transceivers		N	N	
29	Mobile phones		Y	Y	
30	Knives		Y		
31	Site health, safety and environment committee		Y		
32	Site housekeeping and security		Y	Y	
33	Accidental damage, obstruction or interference with assets		N	N	
34	Delivery of materials		N	N	
35	**Conveyance of loads**				
35.1	Conveyance of loads on lifts and escalators		N	N	
35.2	Conveyance of hazardous materials and substances		N	N	
36	Asbestos (non asbestos removal projects)		N	N	
37	Working in or near lifts and escalators		N	N	
38	Work on or adjacent to utilities and High Voltage cables (buried services)		Y	Y	
39	Working on or about the track		Y	Y	

Applicable requirements identified by Client				Applicable requirements identified by Supplier	
Section	**Topic**	**Other documents / Comments**	**Y / N**	**Y / N**	**Reference to explanation - see Section 2a in attached Guidance Notes**
40	Access to electrical sub-stations, working equipment, relay and other secure rooms		N	N	
41	Entering areas with gaseous fire suppression systems		N	N	
42	**Fire prevention**				
42.1	General requirements		Y	Y	
42.2	Temporary fire points		N	N	
42.3	Timber		N	N	
42.4	Composites		N	N	
42.5	Sheeting materials		N	N	
42.6	**Gas cylinders**				
42.6.1	Use of gas cylinders in below ground locations		N	N	
42.6.2	Storage of gas cylinders (above ground)		N	N	
42.7	**Flammable and highly flammable materials**				
42.7.1	Use of flammable and highly flammable materials below ground		N	N	
42.7.2	Storage of flammable and highly flammable materials below ground		N	N	
43	**Hot work and fire hazards**				
43.1	Hot work		N	N	
43.2	Reasonable notice of works		N	N	
43.3	**Precautions**				
43.3.1	Buildings and assets		Y	Y	
43.3.2	Gas cylinders		N	N	
43.3.3	Gas detection		N	N	
44	**Storage**				
44.1	General requirements for storage		N	N	
44.2	Trackside storage		N	N	
44.3	Hazardous materials and substances		N	N	
44.4	Allocation of space on operational property		N	N	
45	Plant and equipment		N	N	

Applicable requirements identified by Client				Applicable requirements identified by Supplier	
Section	**Topic**	**Other documents / Comments**	**Y / N**	**Y / N**	**Reference to explanation - see Section 2a in attached Guidance Notes**
46	Clearance approvals		N	N	
47	Access equipment		N	N	
48	Temporary works		N	N	
49	Temporary fences and hoardings		N	N	
50	**Temporary lighting and power supplies**				
50.1	General requirements		N	N	
50.2	Lighting in tunnels and shafts		N	N	
51	Screening of lights and positioning		N	N	
52	**Environmental requirements**				
52.1	General environmental requirements		Y	Y	
52.2	Environmental nuisance		N	N	
52.3	Water		N	N	
52.4	Waste management		N	N	
52.5	Noise and vibration		N	N	
52.6	Archaeology, historical interest and listed buildings		N	N	
52.7	Wildlife and Habitats		N	N	
52.8	Resource Use		N	N	
52.9	Pest control		N	N	
52.10	Land and water pollution prevention		N	N	
53	**Quality requirements**				
53.1	Records		Y	Y	
53.2	Retention period		Y	Y	
53.3	Availability of records for inspection		Y	Y	
53.4	Statistical process control, audit and inspection procedures		Y	Y	
53.5	General quality requirements		Y	Y	
53.6	Quality Plan		Y	Y	
53.7	Testing and inspection		Y	Y	
53.8	Certification of conformity		Y	Y	

Applicable requirements identified by Client				Applicable requirements identified by Supplier	
Section	**Topic**	**Other documents / Comments**	**Y / N**	**Y / N**	**Reference to explanation - see Section 2a in attached Guidance Notes**
53.9	Quarantine		N	N	
53.10	Traceability		Y	Y	
53.11	Maintenance and servicing		N	N	
53.12	Design		N	N	
53.13	Computer aided design		N	N	
53.14	Asset commissioning and handover		N	N	

Other requirements / comments

With regards Permits amd licences, please clarify what is required.

Client/Supplier approval

Client Menu (Invitation to Tender)

Approved by: Stuart Cooper Signature

Approved by (the Client's representative): Stuart Cooper Signature

Title: Ultrasonic Delivery Manager

Address: Trackside Route, Stratford Market Depot, Bishop Road, E15 2BP

Phone No:

Email: Stuartcooper4@tfl.gov.uk

Revision of this menu:

Supplier Menu (Tender)

Approved by (the Supplier's): SERCO Rail Technical Services Signature

Title: HSEQ Manager

Address: Derwent Hse, Derby, DE24 8UP

Phone No:

Email: Sally.peberday@serco.com

Revision of this menu: 1

Contract Menu (Final Approval of Menu)

Evidence shall be recorded of any amendments to the Client's menu which were agreed in establishing the Contract Menu.

Client's representative approval: Richard Hobson Signature

Supplier's representative acceptance: STUART COOPER Signature

Schedule 7

Deed of Novation

THIS DEED is made day of 201[ ]

BETWEEN:

LONDON UNDERGROUND LIMITED registered in England and Wales under number 01900907 and having its registered office at 55 Broadway, London SW1H 0BD (the "**Company**"); and

[ ] a company registered in [England and Wales] under number [ ] and having its registered office at [ ] (the "**Supplier**"); and

[ ] a company registered in [England and Wales] under number [ ] and having its registered office at [ ] (the "**New Company**").

WHEREAS:

(A) The Company has an agreement dated [ ] and referenced [insert contract number] with the Supplier for the provision of [describe in brief the scope of work/services] (the "**Contract**").

(B) The Company wishes to transfer [part of] its benefit and burden under the Contract to the New Company.

(C) The Supplier and the New Company have agreed to such transfer upon the terms and conditions of this Deed.

IT IS AGREED AS FOLLOWS:

1. In this Deed:

1.1 "**Transfer Date**" means [ ].

2. With effect from the Transfer Date:

2.1 the New Company undertakes to perform the obligations of the Company under the Contract and be bound by its terms in every way as if the New Company is and had been named at all times as a party to the Contract in lieu of the Company;

2.2 the Supplier releases and discharges the Company from all demands and claims whatsoever in respect of the Contract and accepts the liability of the New Company in relation to the Contract in lieu of the liability of the Company and agrees to be bound by the terms of the Contract in

every way as if the New Company were and had been a party to the Contract at all times in lieu of the Company;

2.3 for the avoidance of doubt, it is hereby expressly agreed that:

2.3.1 any and all rights, claims, counter-claims, demands and other remedies of the Supplier against the Company accrued under or in connection with the Contract prior to the date hereof shall be exercisable and enforceable by the Supplier against the New Company; and

2.3.2 any and all rights, claims, counter-claims, demands and other remedies of the Company against the Supplier accrued under or in connection with the Contract prior to the date hereof shall be exercisable by the New Company against the Supplier.

2.4 the Company transfers its rights and obligations under the Contract to the New Company.

3. A person who is not a party to this Deed may not enforce any of its terms by virtue of the Contracts (Rights of Third Parties) Act 1999.

Executed as a deed by the parties and delivered on the date of this Deed

Executed as a deed by affixing the Common Seal of) ……

London Underground Limited) ……

in the presence of: -) *[Authorised Signatory]*

Executed as a Deed by [SUPPLIER])

acting by) ……

) Authorised Signatory

and).....

) Authorised Signatory

Executed as a Deed by [NEW COMPANY]	)
acting by	) ……
	) Authorised Signatory
and	).....
	) Authorised Signatory

Schedule 8

Programme

Assuming a Commencement Date of 26th April 2019 the Programme shall be:

1.1 Contract review meetings chaired by the Contract Manager shall be held when required by the Contract Manager (or the Supplier). These meetings will be held at intervals to be agreed. The Contract Manager shall arrange the meetings and produce minutes that shall be published within 10 working days of the meetings.

1.2. Contract progress meetings shall review the following:

(a) Accuracy of previous meetings;
(b) Supplier's service delivery performance;
(c) Supplier's sub-contracts/invoices;
(d) The Company's reforecast schedule of requirements; and
(e) Other matters from time to time determined to be necessary by the Contract Manager

2. The Completion Date will be 25th April 2020,

2.1. The Company may at its sole discretion extend the duration of the Contract by a further one (1) year on the same Terms and Conditions.

2.2. The Company shall notify the Supplier in writing whether or not it is considering the optional year extension by no later than six months after the Contract Start Date.

2.3. Each extension period is subject to approval and is at the discretion of the Company, they are under no obligation to undertake any of the extension options.

Schedule 9

Not used

Schedule 10

Supplier Performance

Service Delivery Indicators

Ref:	SDI Description	Green	Amber	Red
1.1	**Acknowledgement of Contact:** All requests to be acknowledged within 12 hours of receipt	Greater than or equal to 95%	85% - 95%	Less than 85%
1.2	**Data Analysis:** Data to be analysed and results transmitted to LU within 8 hours receipt.	Greater than or equal to 95%	85% - 95%	Less than 85%
1.3	**Delivery of Goods:** Delivery of Goods in accordance with lead times as stated in Schedule 3.	Greater than or equal to 95%	85% - 95%	Less than 85%

Escalation Process

In the event of unsatisfactory standards, including but not limited to, failure to reach the targets set by the Service Delivery Indicators above, faults open beyond the rectification time and any other deficiencies in performance, the calculation process shall be invoked by the Company in their absolute discretion.

The purpose of the escalation process is to provide a structured framework within which the Parties can address unsatisfactory performance standards against timescales and deliverable targets. For the purpose of this process notified levels of poor performance will be termed 'Non-Conformances'.

This procedure operates within four levels; the lowest level Non-Conformance being Level 1, should Non-Conformance escalate they will receive an appropriate level of management from the Company and the Supplier. Level 3 gives final review and opportunity to remedial actions to solve the issues before Non-Conformance reaches Level 4, which will entitle the Company to terminate in accordance with Clause 20 of the Terms & Conditions of Contract.

In the event that a performance issue is not resolve between the Company and the Supplier then the Non-Conformance may be raised formally to a Level 1 or Level 2 Non-Conformance, depending upon the severity of the performance failure. It is possible for a number of Level 1 and/or Level 2 issues to be in hand at any one time.

Summary of Escalation Process

TRIGGER	LEVEL	ACTION	BY	RESULT
Failure to rectify identified non-conformance issued as part of SDIs.	Level 1	Improvement plan with precise end date required. On-going review dates specified.	Supplier	Satisfactory – Stop Unsatisfactory – Level 2
Level 1 re-occurrence	Level 2	Improvement plan with precise end date required, On-going review dates specified.	Supplier	Satisfactory – Stop Unsatisfactory – Level 3
Level 2 re-occurrence	Level 3	Final review. Final opportunity for remedial action. Precise end date required.	Supplier	Satisfactory – Stop Unsatisfactory – Level 4
Level 3 re-occurrence	Level 4	POSSIBLE TERMINATION		

Issue shall be resolved locally on a day-to-day basis to the mutual satisfaction of all Parties and shall not be raised to Level 1 without prior endeavours to resolve. At this stage of the process, the Supplier may be required to supply a Root Cause Analysis and a Recovery Plan.

Level 1
The Level 1 Non-Conformance will be recorded by the Company and a notice submitted to the Supplier. The Supplier shall in response (such response to be within 10 business days of service of the notice by the Company) prepare and submit to the Company, a Level 1 Non-Conformance Report. Such report will contain:

- Confirmation of the date and details for Level 1 Non-Conformance
- The steps to be taken by the Supplier to ensure there is no repetition of such Level 1 Non-Conformance ("the Level 1 Required Action")
- The time within which such Level 1 Required Action is to be completed (which shall be a reasonable period and no longer than the "Level 1 Rectification Period".

The Supplier and the Company will use all reasonable endeavours to agree the Level 1 Rectification Period and the Level 1 Required Action. If the agreed Level Required Action is carried within the agreed Level 1 Rectification Period then the Non-Conformance will be classed as closed.

Level 2
If the Company determines that a Non-Conformance should be treated as a Level 2 Non-Conformance; or the Supplier fails to provide the Company with a Level 1 Non-Conformance Report within 10 Business Days; or the Supplier fails to rectify the Level 1 Non-Conformance with the Level 1 Rectification Period, then this shall be a "Level 2 Non-Conformance" and the Company will submit a notice to the Supplier.

The Supplier shall in response (such response to be within 10 business days of service of notice by the Company) prepare and submit to the Company a Level 2 Non-Conformance Report. Such report will contain:

1. The date and details of the Level 2 Non-Conformance
2. The Level 2 Required Action.
3. The Level 2 Rectification Period.

The Supplier and the Company will use all reasonable endeavours to agree the Level 2 Rectification Period and the Level 2 Required Action.

If the Level 2 Required Action is taken within the agreed Level 2 Rectification Period then the Non-Conformance will be considered resolved. However a record of the Non-Conformance will be made and Level 2 trends monitored.

Level 3
If the Company determines that the Non-Conformance should be treated as a Level 3 Non-Conformance; or the Supplier fails to provide the Company with a Level 2 Non-Conformance Report within 10 business days; or the Supplier fails to rectify the Level 2 Non-Conformance within the Level 2 Rectification Period, then this shall be a "Level 3 non-Conformance" and the Company will submit a notice to the Supplier.

The Supplier will provide the Company a "Level 3 Non-Conformance Report", setting out the steps which the Supplier has taken, or will take, to ensure no further Non-Conformances of this type shall arise (the "Level 3 Required Action"); and the period (being no greater than 2 months from the time of occurrence of the Level 3 Non-Conformance for the Supplier to put in place steps to ensure that no further Non-Conformance of the same type occur (the "Level 3 Rectification Period").

Level 4
The Supplier fails to provide the Company by the agreed deadline, a Level Non-Conformance Report; or the Supplier fails to undertake the Level 3 Required Action within the Level 3 Rectification Period; or the Supplier fails to rectify the Level 3 Non-Conformance within the Level 3 Rectification Period.

Schedule 11

Not used

EXECUTION PAGE:

This Agreement has been signed by for and on behalf of the parties on the day and year written above.

Signed by

for and on behalf of

London Underground Limited

Name and position of authorised signatory:

LONDON UNDERGROUND LTD

PAUL MALLOWS

SENIOR COMMERCIAL MANAGER.

Signed by

for and on behalf of

Serco Limited

Name and position of authorised signatory:

SERCO LTD

RICHARD HOBSON

DIRECTOR RAIL TECHNICAL SERVICES